SOUTH DAKOTA FISHERIES

2007 Blue Dog Lake Fish Hatchery Annual Production Report

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BLUE DOG LAKE STATE FISH HATCHERY

January 1 – December 31, 2007

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Annual Report

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PREFACE

This document presents a summary of fish production and related activities during the production year 2007 (January 1 – December 31) at Blue Dog Lake State Fish Hatchery, rural Waubay, South Dakota. Copies of this report and references to the data can be made by obtaining permission from the authors or the Director of the Division of Wildlife, South Dakota Department of Game, Fish and Parks, 523 E. Capitol, Pierre, South Dakota 57501-3182.

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EXECUTIVE SUMMARY

During 2007 a total of 101.8 million eggs were incubated, 50.8 million fry were hatched, 1.20 million fingerlings were produced, and 2,000 catchable fish were produced at BDH. In addition, fish production relating to operations in natural rearing ponds provided 12,531 fingerlings. Regional trap and transfer of fishes among waters throughout South Dakota provided 76,628 fish. Specifically, fish production at or associated with BDH yielded the following: 2,000 rainbow trout, 1,490 paddlefish, 5,100 largemouth bass, 104,405 chinook salmon fingerlings, 50,425,000 walleye fry and 1,075,120 walleye fingerlings. BDH personnel provided tours to roughly 300 visitors through the IE center at the hatchery complex and were involved in educational clinics at water festivals and outreach programs that reached 450 children in grades one through four. Finally, BDH personnel managed and maintained the aquarium exhibit at the South Dakota State Fair that was visited by thousands of South Dakota residents and visitors of South Dakota.

In total, BDH expenditures in 2007 were $410,936. Fish production expenditures associated with BDH and other SDGFP fisheries related work were $448,766. A total of $209,048 was expended on walleye production in 2007, which comprised roughly 47 percent of total fish production expenses.

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ANNUAL REPORT

Introduction

Blue Dog Lake State Fish Hatchery (BDH) is located in eastern South Dakota approximately 1.5 miles northwest of the city limits of Waubay. BDH was completed in the fall of 1982 and the facility immediately took over the state's warm- (e.g., black bass, bluegill, crappie) and coolwater (e.g., walleye, muskellunge) fish production.

The hatchery is situated on the northwest shoreline of Blue Dog Lake, where there is abundant high-quality ground and lake water (Figure 1). These waters provide the hatchery with a variety of water temperature supplies for many different uses for both indoor (intensive) and outdoor (extensive) rearing of fish. Inside the hatchery are 700 incubation jars, 20 incubators, and 30 rearing tanks. The building contains a visitor center and aquaria, informative displays and a conference room. Outdoors there are eight raceways and 36 rearing ponds, totaling over 53 surface acres of water. Thirteen fish species have been produced at BDH since its inception. However, walleye (*Sander vitreus*, largemouth bass (*Micropterus salmoides*) and chinook salmon (*Oncorhynchus tshawytscha*) comprised the largest portion of fish rearing activities at BDH during 2007. The objective of this document is to summarize all fish production and related activities that occurred at BDH during 2007.

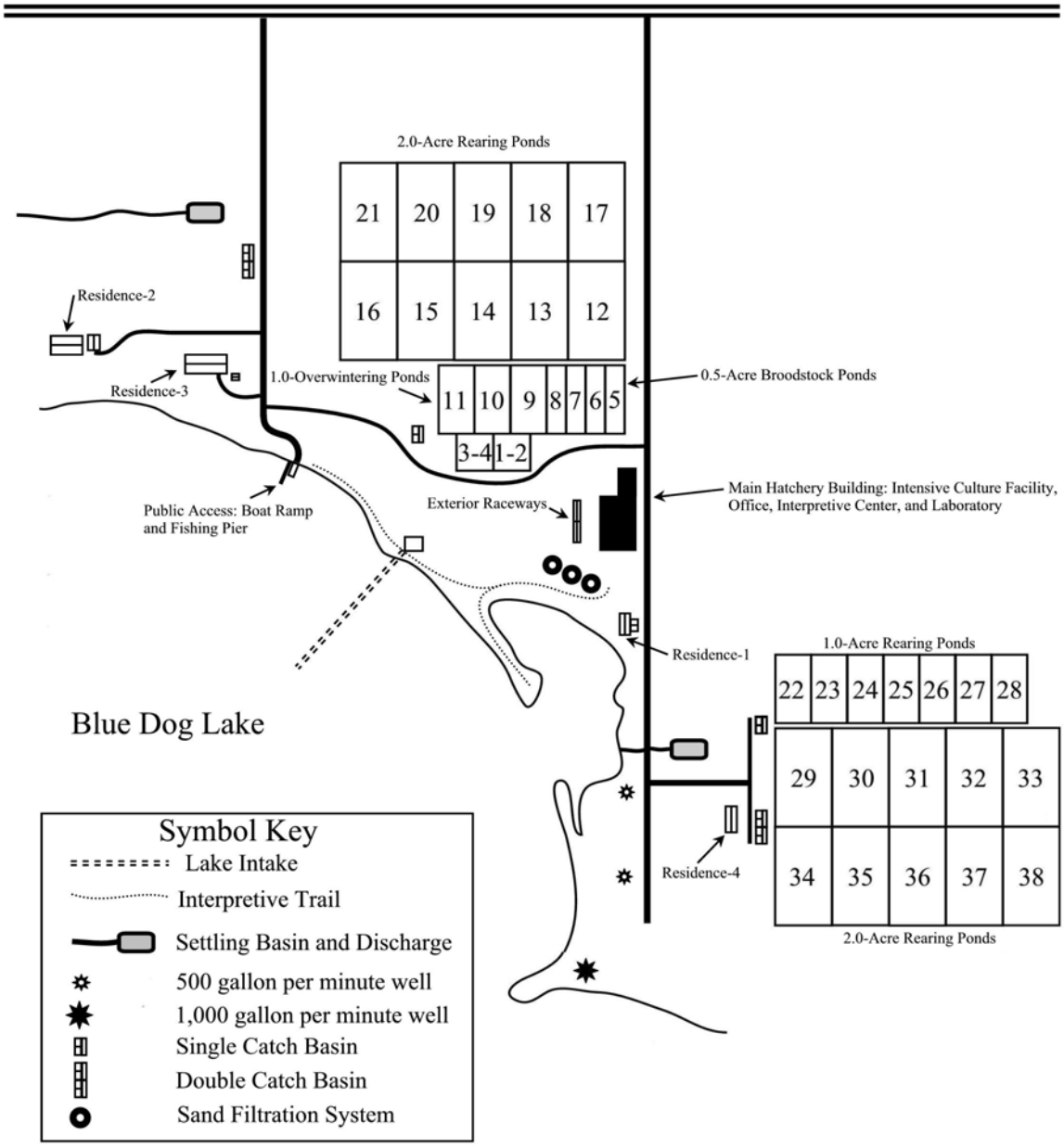
Renovations

Major renovations took place in 2007 and will be completed in 2008. The 2.75 million dollar project addressed the following items:

- Lined 26 acres of earthen bottom ponds with exposed EPDM
- Replaced buried pond valve operators with above ground operators
- Re-sloped 27 acres of north pond unit to restore proper grade for draining
- Installed new pressurized lake water filtration system; includes VFD motor for one lake intake pump
- Removed two sections of tank room floor and poured concrete with proper slope for improved drainage
- Expanded overhead door entrance to allow transfer trucks access to tank room
- Installed VFD on well # 2 to improve efficiency during times of reduced water needs
- Replaced power lines to wells

Although the hatchery was operational during the renovations, fish production was dramatically affected. Only half of the pond space was available and normal production procedures and timing were altered to accommodate construction. Several tasks were performed outside the realm of good fish culture practices. The combination of these factors led to lower production numbers, especially largemouth bass. Therefore the cost per fish produced at Blue Dog was higher than normal in 2007.

Figure 1. Blue Dog Lake State Fish Hatchery.



Hatchery Fish Production

Inter-Hatchery Transfers

BDH received fish and eggs from other states and hatcheries to be released in South Dakota public waters. A complete summary of inter-hatchery transactions completed at BDH is presented in Table 1.

Table 1. Inter-hatchery transfer record of wild fish and fish eggs to (*Received*) or from (Provided) Blue Dog Lake State Fish Hatchery (January 1 – December 31, 2007).

	Size	Quantity	Source or Destination
Received			
Rainbow trout	catchable	2,000	McNenny State Fish Hatchery, Spearfish, SD
Paddlefish	fingerling	14,961	Garrison Dam National Fish Hatchery, Pick City, ND
Yellow Perch	fingerling	187,000	Gavins Point National Fish Hatchery, Yankton, SD
Provided			

Rainbow Trout and Brown Trout

Requests for rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) from BDH are relatively small due to the limited habitat available in eastern South Dakota. Therefore, coldwater fish species (e.g., trout) are typically reared at the state's coldwater hatcheries in western South Dakota (McNenny State Fish Hatchery, MCH; Cleghorn State Fish Hatchery, CLH) and then transferred to BDH for a short time prior to stocking.

On June 06, MCH transferred to BDH a total of 2,000 catchable (8 –10 inch total length, TL) rainbow trout (3.1 fish/lb.). Subsequently, 1,000 rainbow trout were transported immediately and stocked into Hunter's Granite Quarry (Grant County). On June 26, 1,000 additional rainbow trout were stocked into the Quarry.

Expenditure

A total expenditure of $8,515.00 ($4.26 for each fish) was incurred for trout production at BDH (Table 2).

Table 2. Expenditures associated with production of catchable rainbow trout at Blue Dog Lake State Fish Hatchery (January 1 – December 31, 2007).

Item	Expenditure ($)
Blue Dog Costs	8,515.00
Total	8,515.00
Per 1,000	
Per fish	4.26

Yellow Perch

Yellow perch (*Perca flavescens*) were collected using modified-fyke nets in Lake Alvin, South Dakota during spring 2007. Spawning females were manually stripped of their eggs and fertilized using the dry method. Fertilized egg masses were immersed into a 5-gallon bucket and transported to Blue Dog Hatchery. Upon arrival, egg masses were removed from the bucket and random 50-g subsamples were placed in incubating trays. Larger subsamples were desired, but an inadequate amount of fertilized eggs were available. Treatments consisted of a control, 1.0% (10 g/L), 1.5% (15 g/L), and 2.0% (20 g/L) sodium sulfite solutions. In all treatments, sodium sulfite was dissolved in 200-mL of hatchery supply water to produce the varying concentration. All treatments were replicated four times.

Each treatment solution was poured over the 50-g subsample of fertilized eggs (3-8 h post-fertilization) within the incubation tray. The incubation trays were agitated continuously for 30-75 min. Eggs were rinsed at least 4 times with equal volumes of hatchery supply water to remove the dissolved matrix and remaining sodium sulfite solution. The time required for dissolution and effects on egg masses were checked and recorded. Separated egg masses were transferred to incubation/hatching jars.

Treatments were assigned to each egg mass in a completely randomized experimental design (4 replicates of each treatment for a total of 16 jars). Hatchability (percent hatch) was determined by taking a subsample of each jar (400 – 1,200 eggs) and counting the number of viable eggs. No yellow perch fry were preserved to check for abnormalities or skeletal deformities; however, this should be investigated during future evaluations.

The time required to completely dissolve the egg mass matrix was measured with a stopwatch. Mean times to complete each task were calculated but this data is currently unavailable. Personal observation indicated that a negative linear relationship was evident, whereby as the sodium sulfite concentration increased the time required to dissolve the matrix decreased. Stirring and agitating the egg masses using the 1.0% solution did not always result in a completely dissolved matrix. If the matrix was not dissolved after 80 minutes, we stopped and transferred the eggs to a hatching jar. Chi-square analyses were performed to

determine whether the proportion of viable eggs was significantly different (alpha = 0.05) between the control and each treatment.

All treatments exhibited a mean hatchability of 80% or greater, including the control (Table 3). However, standard error variability among control replicates was 3 to 6 times greater than sodium sulfite treatment variability. The highest hatchability (90%) occurred using the 1.0% sodium sulfite treatment. Chi-square analyses indicated that the 1.0% and 1.5% sodium sulfite solutions yielded significantly different proportions of viable eggs than the control treatment. Further evaluations are needed; however, preliminary results indicate dissolving yellow perch egg matrixes with a 1.0% sodium sulfite treatment provides a method for consistent increased percent hatch.

Table 3. Sample size (N) and mean percent viable eggs (mean hatchability) for individual sodium sulfite treatments. Standard errors are presented in parentheses. Chi-square test statistic (X^2), degrees of freedom (df), and associated p-value (probability of committing a Type I Error) for individual treatment versus control comparisons.

Treatment	**N**	**Mean Hatchability (SE)**	**X^2**	**df**	**P-value**
Control	4	80 (7)	-	-	-
1.0%	4	90 (1)	114.8	1	<0.01
1.5%	4	87 (1)	47.5	1	< 0.01
2.0%	4	81 (2)	3.18	1	0.08

Yellow perch fry were successfully hatched and subsequently stocked into a 7-acre natural rearing wetland on the second week of May. Four miniature modified-fyke nets were set in the natural wetland on September 17, 2007 and fished for a 24-h period to test for age-0 yellow perch abundance. Approximately 67.5 lbs of yellow perch were collected on September 18, 2007 and released. Further effort was then designated towards harvesting age-0 yellow perch for overwinter intensive culture evaluations at BDH and South Dakota State University. Harvest occurred through October 3, 2007. In 36-net nights, approximately 230 lbs of yellow perch were harvested that ranged in size from 14.1 to 16.5 fish per pound (Table 4).

Table 4. Age-0 yellow perch harvest (lbs) from 7-acre natural rearing wetland during 2007. Date, water temperature (C; Celsius), total YEP (yellow perch) harvested (lbs; pounds), N (number of net nights; 1-net night was considered a continuous 24-hour set), and mean rate (mean number of yellow perch per lb) accompanied with SE (Standard Error) and n (number of sample counts completed).

Date	**Water temp (C)**	**Total YEP harvested (lbs)**	**N**	**Mean rate (SE, n)**
9-18-07[1]	16.1	67.5	4	14.1 (1.1, 4)
9-25-07	15.6	38.4	4	16.5 (na, 1)
9-26-07	14.3	42.9	4	15.6 (na, 1)
9-27-07	14.3	21.6	4	16.3 (0.9, 2)
9-28-07	13.8	21.3	4	14.8 (0.9, 2)
10-1-07	15.0	74.3	12	16.3 (0.7, 2)
10-3-07	13.8	29.7	8	-
Total[2]		228.2	36	

[1] All yellow perch were released back into natural rearing wetland.
[2] Total does not include 9-18-07 yellow perch harvest numbers because those fish were released.

Expenditure

A total expenditure of $45,609.00 was incurred for yellow perch production in 2007 (Table 5).

Table 5. Expenditures associated with experimental production of yellow perch at Blue Dog Lake State Fish Hatchery (January 1 – December 31, 2007).

Item	Expenditure ($)
Egg procurement, incubation intensive fingerling and overwintering	45,609.00
Total	45,609.00

Chinook Salmon 2006 -2007

Chinook Salmon eggs originating from Whitlocks Bay area, Lake Oahe were received at BDH during October 2006. Initially 601,570 eggs were incubated. An additional 25,000

"eyed" eggs from MCH were added. Total eggs incubated at BDH were 626,570. An estimated 133,720 fry were later placed in rearing tanks. Overall percent hatch was 21.3. Fry were placed on feed in December and fed daily through March. Fingerling salmon were stocked on April 2 and April 4, 2007. All fingerlings were stocked into Whitlock Bay (Lake Oahe). Total fingerling production was an estimated 104,405 salmon. Fingerlings ranged in size from 55 – 75 fish per pound at time of stocking and total length ranged from 3.5 – 3.9 inches (Table 6). Percentage of initial fry surviving until stocking was 78.1.

Expenditure

A total of $70,798 was spent for the 2006 portion of Chinook Salmon production. Expenses in 2007 were $62,785 resulting in a total cost of $133,583 (Table 7).

Table 6. Chinook salmon egg procurement (N), fry hatched (n), fingerlings produced at Blue Dog State Fish Hatchery during 2006 and 2007. Ranges of rate (number of salmon per lb) and total length (inches) are also presented.

Eggs (N)	Fry (n)	% Hatch	Stocked (n)	Rate	Total Length
626,570	133,720	21.3	104,405	55 – 75	3.5 - 3.9

Table 7. Expenditures associated with Chinook salmon at Blue Dog Lake State Fish Hatchery (January 1 – December 31, 2007).

Item	Expenditure ($)
Egg procurement, incubation, initial rearing	70,798 (06 cost)
Spring 07 rearing	62,785
Total cost	133,583
Per fish	1.28

Paddlefish

Excess paddlefish (*Polyodon spathula*) from Garrison Dam National Fish Hatchery were offered to BDH in August 2007. Total number of paddlefish fingerlings received at BDH was 14,960. Upon arrival fingerlings were placed into tank room rearing tanks. One lot of fingerlings were approximately 20 fish per pound with total number of 8,598, the second lot were 60 fish per pound with total number of 6,362. Missouri River fisheries staff from Chamberlain were on site to place coded wire tags into the fingerlings. The larger fingerlings were tagged without incidence, however the second group of fingerlings were not accepting the tag. The smaller fingerlings were allowed some growing time and tagged just prior to stocking. Each size group was kept separate and transported to grow out ponds on site at BDH. Each group were stocked into one newly lined 2-acre pond. Each pond received a chopped alfalfa fertilization regime throughout the grow out period. Fertilization rate was

125lbs./acre and occurred on ten day intervals. Within one day post-stocking several species of gulls numbering in the hundreds took up residence on the adjacent pond dikes. Several attempts to keep the gulls away were made but nothing proved to be successful. Visual inspections and periodic seine pulls were made in the ponds. Each method proved that paddlefish fingerlings were present. After 36 days in the pond it was determined that the untagged fish were of size to be tagged and stocked. On September 19, the untagged fingerling pond (pond 18) was drained. Harvest provided no fingerlings returned. One interesting note is that visual inspection of this pond two days prior to draining proved fingerlings still were present in adequate numbers. This was a total loss of 6,362 fingerlings primarily due to bird depredation. On September 21 the second fingerling pond (pond 13) was drained and 1,490 paddlefish were harvested. Rate was 7 fish per pound and percent return was 17.3 (Table 8). Paddlefish fingerlings were stocked into Lake Francis Case near Oacoma, SD.

Expenditure

A total expenditure of $25,672 was incurred for paddlefish production at BDH in 2007 (Table 9).

Table 8. Rearing information (pond number, date stocked (Stock), date harvested (Harvest) number of days reared (Days), Stock information (number stocked (N), and Harvest information (number harvested (n), percent return (Return, %), total weight (Weight, lbs.) and rate (Rate, fish/lb.) for paddlefish cultured in extensive rearing ponds at Blue Dog Lake State Fish Hatchery during 2007 (August 16 – Septemeber 21).

	Rearing			Stock	Harvest			
Pond	Stock	Harvest	Days	N	n	Return	Weight	Rate
13	8-16	9-21	38	8,598	1,490	17.3	213	7.0
18	8-16	9-19	36	6,362	0	0.0	--	--
Total	---	---	---	14,957	1,490	9.9	213	7.0

Table 9. Expenditures associated with production of paddlefish at Blue Dog Lake State Fish Hatchery (July 2007 – October 2007).

Item	Expenditure ($)
Blue Dog Costs	25,672.00

Walleye

Walleye production at BDH during 2007 included the incubation of 101.8 million eggs, the hatching of 50.4 million fry, and the harvest of 1.1 million small fingerlings (Phase I fingerlings) from extensive rearing ponds.

Broodfish Collection, Egg Procurement and Spawning

Spawning operations conducted in South Dakota by the SDGFP included the collection of adult walleye with 0.75 or 1.00 inch frame nets between April 16 and April 25, 2007 (Table 10). A total of 101.8 million walleye eggs were collected from South Dakota waters and incubated at BDH during 2007 (Table 11). All walleye eggs incubated at BDH were harvested from South Dakota waters during 2007. Spawning locations in 2007 included Grand River (Lake Oahe), Horseshoe Lake (Day County), Moreau River (Lake Oahe) and Reid Lake (Clark County). To induce spawning, "green" females were kept in holding nets at all spawning locations for up to three days. If females had not spawned by the fourth day of holding, the fish were released to the wild. Holding females resulted in 15,444,000 eggs (48.5%), 12,217,000 eggs (41.4%), 12,225,000 eggs (34.3%) and 520,000 eggs (10.9%) from Grand River, Horseshoe Lake, Moreau River and Reid Lake respectively.

Fry Production

Walleye eggs were received at BDH for a span of 9 days (April 18 – April 26). Upon arrival, eggs were processed as follows: 1) tempered to hatchery water temperature, 2) placed in incubation jars (2,000 mL/jar), and 3) given initial pickoff with a hand siphon if necessary. One day after arrival when the eggs had fully water-hardened, eggs were measured (egg diameter) using a six-inch Von-Bayer trough. Walleye eggs were subjected to daily, 15-minute flow through prophylactic treatments of formalin (1,667 mg/L) to prevent egg mortality due to fungal infestation (e.g., *Saprolegnia* spp.).

A total of 50,425,000 walleye fry were produced and an overall percent hatch of 49.6 percent was achieved (Table 11). Eggs collected from Grand River, Horseshoe, Moreau River and Reid yielded hatch success rates of (50.8%), (50.2%), (48.8%) and (43.5%) respectively.

Table 10. Spawning information for operations conducted at South Dakota spawning stations (April 16 – April 25, 2007).

Location	Netting			Male Walleye		Female Walleye			
	Begin	End	Nets (n)	Captured	Spawned	Captured	Held	Ripened	Spawned
Grand River		04-25	194	4,679	1,300	1375	558	297	608
Horseshoe	04-16	04-25	180	325	325	461	159	106	256
Moreau River	04-16	04-25	147	4,291	630	950	362	163	478
Reid	04-20	04-25	37	90	90	115	18	7	64
Total	04-19 04-16	04-25	558	9,385	2,345	2,901	1,097	573	1,406

Table 11. Walleye egg procurement from South Dakota waters, and fry production at Blue Dog Lake State Fish Hatchery, 2007.

Location	Walleye		
	Eggs (N)	Fry (n)	Hatch Percent
	South Dakota		
Grand River	31,814,000	16,150,000	50.8
Horseshoe	29,506,000	14,808,000	50.2
Moreau River	35,685,000	17,400,000	48.8
Reid	4,756,000	2,067,000	43.5
Total	101,761,000	50,425,000	49.6

Fingerling Production

Earthen bottom ponds were stocked with walleye fry for a period of 3 days between May 13 and May 15. Pond temperatures at the time of stocking ranged from 58 to 60 °F. In total, ten 2.0-acre ponds were stocked with walleye fry (Table 12). The extensive rearing pond stocking schedule included: 75,000 fry/acre in ten 2.0-acre ponds.

Ponds were filled with unfiltered lake water about 3-days prior to walleye stocking to inoculate the ponds with initial nutrients, phytoplankton, and zooplankton. In addition, an initial fertilization application was administered that included chopped alfalfa (250 lbs./acre) and yeast (25 lbs./acre). This initial application of chopped alfalfa was utilized to stimulate nitrogen and carbon fixing benthic bacterial populations and subsequent heterotrophic production. Ponds were also supplemented with chopped alfalfa (125 lbs./acre) administered at 10-day intervals throughout the remainder of the walleye grow-out season as an additional organic nitrogen and phosphorus source. Ponds were monitored for water quality (e.g., temperature, dissolved oxygen, and pH) with a YSI Model 6000 deployable environmental monitoring system (YSI Incorporated). In addition, weekly horizontal plankton tows and shoreline seining was conducted to monitor walleye growth and food availability, respectively.

Walleye fingerlings were harvested for a period of 5 days in June (June 18 – June 22) resulting in an average rearing duration of 38 days. Overall, a total of 1,075,120 phase I walleye fingerlings were produced with a combined weight of 861.0 lbs. and an overall size of 1,250 fish/lb (Table 12). The survival of walleye in extensive rearing ponds averaged 71.7 percent (range, 57.9 to 95.2 percent). Ideal rearing conditions for walleye apparently include water temperatures at the time of stocking near 55 °F, gradually warming post-stocking water temperatures, and the avoidance of drastic temperature fluctuations that can cause rapid fry mortality.

Expenditure

Total expenditures associated with walleye production at BDH during 2007 were $202,966 (Table 13). Walleye fry and fingerling were produced at BDH at a cost of $2.47 and $72.84 for each 1,000 fish produced, respectively.

Table 12. Rearing information (date stocked, Stock; date harvested, Harvest; number of days reared, Days), numbers (fry stocked, N; fingerlings harvested, n), percent return (Return, %), total weight (Weight, lbs.), and rate (Rate, fish/lb.) for walleye cultured in extensive rearing ponds at Blue Dog Lake State Fish Hatchery during 2007 (May 13 – June 22).

	Rearing			Stock	Harvest			
Pond	Stock	Harvest	Days	N	n	Return	Weight	Rate
29	05-13	06-18	36	150,000	94,320	62.9	72.0	1,310
30	05-13	06-19	37	150,000	101,920	67.9	56.0	1820
31	05-14	06-20	37	150,000	142,800	95.2	102.0	1400
32	05-14	06-21	38	150,000	135,420	90.1	111.0	1,220
33	05-14	06-22	39	150,000	105,840	70.6	126.0	840
34	05-13	06-18	36	150,000	106,560	71.0	74.0	1,440
35	05-13	06-19	37	150,000	113,600	75.7	71.0	1,600
36	05-15	06-20	36	150,000	86,800	57.9	62.0	1,400
37	05-15	06-21	37	150,000	98,820	65.9	81.0	1,220
38	05-15	06-22	38	150,000	89,040	59.4	106.0	840
Total	---	---	---	1,500,000	1,075,120	71.7	861.0	1,250

Table 13. Expenditures associated with walleye fry and small fingerling (Phase I fingerling) production at Blue Dog Lake State Fish Hatchery (January 1 – December 31, 2007).

	Expenditure ($)		
Item	Fry	Fingerling	Total
Spawning	47,955.00	---	
Blue Dog Costs	76,702.00	78,309.00	
Total	124,657.00	78,309.00	202,966
Per 1,000	2.47	72.84	---
Per fish	<0.01	0.07	---

Black Bass

Black bass (largemouth bass and smallmouth bass) have been requested from BDH by fisheries managers for introductory, supplemental, and maintenance stocking programs throughout South Dakota. As a result, black bass have been reared each year since BDH began fish production in 1983. However, requests for each largemouth bass and smallmouth bass by fisheries managers often fluctuate from year-to-year. Thus,

black bass adults have been collected from wild fish populations and maintained at BDH as broodstock. Typically, black bass are allowed to spawn naturally in the extensive rearing ponds (spawning pond) at BDH. Subsequently, the spawning ponds are drained and the black bass small fingerlings and broodstock are separated after which the small fingerlings are restocked into ponds (grow out ponds) until late fall (e.g., September).

Broodstock Maintenance

Black bass broodfish (average weight, 2.0 – 4.0 lbs.) were overwintered in one, 1.0-acre pond at the hatchery (Table 14). Overwintering pond was drained in early spring and the black bass broodstock were held in 48 °F unfiltered well water until pond spawning conditions became favorable. The practice of delaying black bass spawning by holding broodfish in cool well water effectively decreased the potential for mortality induced by post-spawn temperature fluctuations in the rearing ponds. In addition, the delay of black bass spawning enables the use of 2.0-acre rearing ponds for each walleye and bass culture because walleye are typically harvested during late June prior to bass harvest from spawning ponds and transfer to grow-out ponds. The black bass broodstock were introduced into the spawning ponds in late-May and after spawning was complete the bass spawning ponds were drained. To save time and possibly increase small fingerling numbers the spawning ponds were drained with both adults and small fingerlings simultaneously, which has been successful in previous years. The black bass broodstock were then transferred into a 1.0-acre overwintering pond and supplemented with fathead minnows at a rate of 2.5 lbs. for each pound of bass throughout the summer (July – October).

Spawning

Largemouth bass broodfish were stocked into seven, 1.0-acre extensive rearing ponds (14 female and 18-19 male each ; Table 15). All largemouth bass spawning ponds were stocked on May 21 and subsequently drained from July 5 to July 12. A total of 403,530 largemouth bass small fingerlings were harvested from spawning ponds. The overall yield of largemouth bass from spawning ponds was 57,647 fingerlings per surface acre (4,118 fingerlings per female). Largemouth bass collected from spawning ponds ranged in size from 1,550 to 4,100 bass per pound. The total weight of largemouth bass harvested from spawning ponds was 188.2 lbs. with an average yield based on weight of 26.9 lbs./surface acre.

Table 14. Black bass (largemouth bass) broodstock over wintering pond schedule at Blue Dog Lake State Fish Hatchery (Fall 2006 through Fall 2007).

	Pond		Fall 2006	Spring 2007		Fall 2007
Species	Number	Size (Acre)	Stock	Recovery (n)	Recovery (%)	~~Stock~~
Largemouth bass	11	1.0	256	230	89.8	226
Total	---	---	256	230	89.8	226

Table 15. Rearing information (date stocked, Stock; date harvested, Harvest; number of days reared, Days), numbers (male broodfish stocked, Male; female broodfish stocked, Female; fingerlings harvested, n), total weight harvested (Weight, lbs.), size of fingerlings (Rate, fish/lb.), and yield (number of fingerlings per female, Per Female; number of fingerlings per surface acre, Per Acre) for black bass (largemouth bass) reared in 0.5 and 1.0-acre extensive ponds at Blue Dog Lake State Fish Hatchery (May 21 – July 12, 2007).

	Rearing			Stock		Harvest			Yield	
Pond [1]	Stock	Harvest	Days	Male	Female	n	Weight	Rate	Per Female	Per Acre
					Largemouth bass					
22	05-21	07-05	45	19	14	84,870	20.7	4,100	6,062	84,870
23	05-21	07-06	46	19	14	55,460	23.5	2,360	3,961	55,460
24	05-21	07-06	46	19	14	72,200	38.0	1,900	5,157	72,200
25	05-21	07-10	50	19	14	62,000	40.0	1,550	4,429	62,000
26	05-21	07-11	51	19	14	17,000	8.5	2,000	1,214	17,000
27	05-21	07-11	51	19	14	90,000	45.0	2,000	6,429	90,000
28	05-21	07-12	52	18	14	22,000	12.5	1,760	1,571	22,000
Total	---	---	---	132	98	403,530	188.2	2,144	4,118	57,647

[1] All ponds were 1.0-acres in surface area

Fingerling Production

Black bass fingerlings were cultured during the grow-out season in ponds that had previously been drained for the harvest of walleye. Subsequently, black bass grow-out ponds were immediately filled with unfiltered lake water after draining and prior to black bass stocking. Black bass grow-out ponds were supplemented with chopped alfalfa (125 lb./acre) as a source of organic nitrogen and phosphorus initially upon refilling and with three additional applications during the grow-out season. Similar to walleye culture explained previously, the initial application of chopped alfalfa was utilized to stimulate nitrogen and carbon fixing benthic bacterial populations and subsequent heterotrophic production. In addition, unfiltered lake water was added continuously to all of the ponds to aid in aeration and the removal of harmful dissolved gasses (e.g., ammonia). Ponds were monitored for water quality (e.g., temperature, dissolved oxygen, and pH), with a YSI Model 6000 deployable environmental monitoring system (YSI Incorporated).

An estimated 403,530 small fingerling largemouth bass were harvested from spawning ponds and were transferred to seven, 2.0-acre extensive rearing ponds for the grow-out season (Table 16). The stocking rates of largemouth bass into grow-out ponds based on numbers were 28,820 (range, 11,000 – 35,500) fingerling bass per surface acre and 13.4 lbs. (range, 6.25 – 20.0) per surface acre based on weight. Largemouth bass were stocked into grow-out ponds from July 5 to July 12 and subsequently drained from August 27 to September 6.

A total of 5,100 largemouth bass fingerlings were harvested from grow-out ponds with an overall return percent from stock to harvest of 1.3 (range, .4 – 3.4). The overall yield of largemouth bass from grow-out ponds based on numbers was 364 (range, 110 – 800) fingerlings per surface acre. Largemouth bass collected from grow-out ponds ranged in size from 20 to 60 bass per pound. The total weight of largemouth bass harvested from spawning ponds was 208.0 lbs. with an average yield based on weight of 14.9 lbs./surface acre.

Pond renovations which occurred at BDH in 2007 may have had an adverse effect on largemouth bass fingerling production. Due to renovations the only ponds available for bass production were ponds that had just received an exposed rubber liner. Also, the number of available ponds was less than half of what are normally used for fingerling production. Ponds were stocked with small bass fingerlings immediately after filling. Once ponds are filled normal culture practices require about a 1 week period prior to stocking to allow proper nutrient levels and adequate zooplankton populations to establish. In summary, ponds were severely overstocked and food sources did not establish until approximately 2 weeks into the grow out period. This combination was probably the demise of most small fingerlings that were stocked into these ponds.

The culture of black bass at BDH has been a successful program since BDH began fish production in 1983; however, one area of concern is of special interest relating to bass culture at BDH.

Table 16. Rearing information (date stocked, Stock; date harvested, Harvest; number of days reared, Days), Stocking information (number stocked, N: total weight stocked (Weight, lbs.), size stocked, (Rate, fish/lb.), Harvest information (fingerlings harvested, n), total weight harvested (Weight, lbs.), size of fingerlings (Rate, fish/lb.), percent return, (Return %) and yield (number of fingerlings, Number; weight of fingerlings, Weight; per surface acre) for black bass (largemouth bass) reared in 2.0-acre extensive ponds at Blue Dog Lake State Fish Hatchery (July 5 – September 6, 2007).

	Rearing			Stock			Harvest				Yield	
Pond	Stock	Harvest	Days	N	Weight	Rate	n	Weight	Rate	Return	Number	Weight
					Largemouth bass							
14	07-11	09-04	55	71,000	35.5	2,000	460	23.0	20	.6	230	11.5
16	07-11	08-30	50	62,000	40.0	1,550	1,020	17.0	60	1.6	510	8.5
17	07-12	09-05	55	22,000	12.5	1,760	740	37.0	20	3.4	370	18.5
18	07-06	08-27	52	72,200	38.0	1900	780	26.0	30	1.0	390	13.0
19	07-06	09-06	62	55,460	23.5	2.360	1,600	80.0	20	2.9	800	40.0
20	07-05	08-30	56	54,120	13.2	4,100	220	11.0	20	.4	110	5.5
21	07-05	09-04	61	66,750	25.5	2620	280	14.0	20	.4	140	7.0
Total	---	---	---	403,530	188.2	2,144	5,100	208.0	24.5	1.3	364	14.9

Fisheries managers have expressed concern regarding the success of stocking largemouth bass produced at BDH. Specifically, it is believed that largemouth bass of the size provided by BDH during the fall are insufficient to maintain an appropriate over-winter survival in the wild. Apparently, stocking programs in eastern South Dakota have generally failed using fingerling largemouth bass from BDH. Published literature suggests that over-winter survival of largemouth bass post-stocking generally depends on sufficient energy reserves; therefore, the larger the size of the fish stocked the better the chance for recruitment (e.g., Pine et al. 2000).

An attempt to once again produce largemouth bass that would be better suited for stocking in public waters was performed in 2006 and 2007. BDH has in the past over-wintered largemouth bass fingerlings in extensive rearing ponds on unfiltered well water. This attempt followed the same protocol as past years. During September 2006, one 0.5-acre pond was filled and stocked with 2,740 largemouth bass fingerlings. Fingerlings were 60 fish per pound at time of stocking. Small minnows were added to the over-wintering pond as a food source. Overwintered largemouth bass fingerlings were harvested April 17. Harvesting provided 285 large fingerlings. Total pounds equaled 35.0, number of fish per pound was 8.0 and percent return equaled 10.4

Expenditure

Of the total expenses incurred at BDH for largemouth bass production $17,046 (17.5%) was spent on broodstock maintenance and $80,091 (82.5%) on direct costs of fingerlings production (Table 17). Largemouth bass broodstock were maintained at BDH at a cost of $74.11 for each fish .

Table 17. Expenditures associated with broodstock care and fingerling production of black bass at Blue Dog Lake State Fish Hatchery (January 1 – December 31, 2007).

Item	Expenditure ($)		
	Broodfish	Small Fingerling	Medium Fingerling
	Largemouth bass		
Blue Dog Costs	17,046	32,600.00	47,491.00
Per 1,000	---	80.79	-----
Per fish	74.11	0.08	9.31

Chemical Use and Disease Treatment

Pathogens, parasites, and aquatic nuisance species (ANS) are a serious issue for fish hatchery management. The occurrence and/or spread of any diseases caused by a pathogen, parasite or ANS at BDH could result in devastating effects on fish production. Therefore, procedures that promote healthy fish production and the avoidance of

transferring harmful pathogens, parasites and ANS are perpetually implemented at BDH. Generally, BDH adheres to the SDGFP health management policy to prevent the introduction or spread of aquatic animal pathogens into areas where they are not known to occur in the State of South Dakota. In cases where fishes are identified as abnormal the infected fishes are removed from the general population immediately upon identification of symptoms and the underlying cause is quickly identified so appropriate actions can be initiated (Piper et al. 1982).

The occurrence of unwanted pathogens, parasites, and ANS are kept to a minimum at the hatchery by a consistent prophylactic chemical treatment program. For example, the majority of fish reared at the hatchery or handled by the hatchery crew receive some type of prophylactic treatment such as baths or flow-through treatments. All bath treatments are administered with forced air to prevent oxygen depletion while the fresh water flow is absent. In addition, fungal formation during egg incubation of walleye, northern pike and Chinook salmon eggs is avoided by the administration of daily treatments of an approved chemical concentration (e.g., 1,667-mg/L formalin or 500-mg/L hydrogen peroxide). These 15-minute, flow-through treatments are delivered with a peristaltic pump under supervision by hatchery staff.

The continued disinfecting of equipment (e.g., dip nets, rearing tanks, hauling tanks, etc.) is important to avoid transfer of pathogens, parasites or ANS among waters. During the rearing season used equipment (e.g., dip nets, brushes, etc.) is submerged in benzylkonium chloride (1,200 mg/L). Hauling tanks are typically disinfected with HTH (calcium hypochlorite) at a concentration of 100 mg/L.

Information and Education

The promotion of educational opportunities for the general public is demonstrated throughout the year at BDH. First, the hatchery complex contains an information and education (IE) center that houses 17 fish mounts, fish facts (e.g., anatomy, age, growth, movement, temperature preferences, etc.), lake dynamic illustrations (e.g., annual cycle, hydrological cycle, oxygen cycle), freshwater ecology information (e.g., aquatic food web), and the walleye fry production process. The IE center also contains a 700-gallon aquarium that provides the public with opportunity to view live fish species that are present throughout South Dakota. If desired, the IE center provides the opportunity for visitors to view a slide show that demonstrates common practices at BDH. The slide shows at BDH are designed for various audiences (adult show, 18-minute duration; children show, 5-minute duration). Outside, the hatchery maintains hundreds of rainbow trout and brown trout in a raceway that provides the opportunity for visitors to feed fish. Furthermore, a trail is maintained that provides the public access to a wetland and Blue Dog Lake. The hatchery complex's IE center is open to the public during regular office hours (8:00 AM to 4:30 PM, Monday – Friday). During summer months (May – September) a seasonal intern operates the IE center at BDH, which is open during weekend hours (8:00 AM to 4:30 PM, Saturday – Sunday). In 2007, the IE center at BDH was visited by roughly 300 visitors. Visitors at BDH were provided guided tours of

the hatchery complex and the opportunity to view hatchery processes when events were in progress.

Educational opportunities for the public often extend beyond the BDH boundaries. BDH personnel are frequently present at festivals, fairs, and other educational events associated with water. Finally, the South Dakota State Fair aquarium displays were maintained and managed by personnel from BDH.

Water Quality Monitoring

Water quality is extremely important to the successful production of fish at BDH. The hatchery utilizes two water sources, well water and lake water. The major differences between well water and lake water are temperature and turbidity. Well water is typically 48 to 50 °F and lake water can reach temperatures in excess of 80 °F. In addition, filtered lake water is more turbid than well water, which often interferes with visual observations of the fish. All water used in the hatchery is passed through an aeration tower which results in oxygen saturation levels of approximately 93.0 percent and the removal of undesired gases (e.g., nitrogen). Monitoring of BDH water is conducted through annual analysis at the South Dakota Department of Health laboratories, Pierre. Generally, BDH water maintains a pH of 7.4 to 8.0, unionized ammonia levels less than 0.06 mg/L, total iron of 0.2 mg/L, and manganese concentration of 0.61 mg/L. During egg incubation and intensive fish rearing an iron and manganese filtration system reduces the concentration of the dissolved solids to 0.01 and 0.03 mg/L, respectively.

Natural Rearing Pond Production

Natural rearing ponds (NRP) in eastern South Dakota have been utilized for fish production purposes. Rearing fish in NRP can be beneficial because the process utilizes the natural fertility of surface water, requires minimal or no maintenance during the growing season, and because natural waters on state or federal land are available for fish production. Fish species that have been produced in NRP include largemouth bass, walleye and yellow perch. During 2007 a total of 12,531 walleye were harvested from NRP in eastern South Dakota (Table 18). The total weight of walleye harvested from NRP was 565 lbs. Fingerling walleye that were stocked as fry during spring 2007 comprised 100.0 percent of walleye harvested from NRP.

Table 18. Number of walleye harvested (Number), total weight harvested (Weight, lbs.), size of fish harvested (Rate, number/lb.) and total expenditure of harvest from natural rearing ponds during 2007 (January 1 – December 31). Walleye fingerling harvest occurred in ponds stocked (Stock, x 1,000) with fry.

	Species			Harvest			
Lake	Common Name	Type	Stock	Number	Weight	Rate	Expenditure ($)
Region IV							
Bailey	Walleye	Fingerling	750	1,125	125	9.0	608.19
Bury	Walleye	Fingerling	500	2,346	138	17.0	1,216.38
Hauge	Walleye	Fingerling	1,000	---	---	---	608.19
Peterson	Walleye	Fingerling	1,400	9,060	302	30.0	3,649.10
Total	Walleye	Fingerling	3,650	12,531	565	---	6,081.86

Expenditure

A total of $6,081.86 was directly spent on NRP related activities including harvest and stocking (Table 19). A total of $486.55 was spent for each 1,000 walleye harvested. The overall expenditure for each pound of fish harvested from natural rearing ponds was $10.76. Expenditures do not include the cost of stocked fry.

Table 19. Expenditures associated with production of walleye in natural rearing ponds in eastern South Dakota (January 1 – December 31, 2007).

Item	Expenditure ($)
Walleye	
Harvest expenses	6,081.86
Per 1,000	486.55
Per fish	0.49
Per pound	10.76

Trap and Transfer Operations

Trap and transfer operations were undertaken on several lakes in 2007. These operations serve several purposes such as removing fish from possible summerkill or winterkill situations, alleviating overpopulation, and providing a source of valuable fish to be restocked in new locations. Eleven fish species were transferred among waters during 2007 which included: black bullhead, black crappie, bluegill, brook trout, smallmouth bass, channel catfish, redear sunfish, largemouth bass, northern pike, walleye, and yellow perch. Yellow perch, black crappie, and bluegill were transferred among South Dakota waters in three of the four regions (Table 20).

A total of 76,628 fish of various species were trapped from public waters in South Dakota and again stocked in other South Dakota waters. Based on the numbers, 94.9% of all fish transferred were made up of yellow perch (45,593 transferred), walleye (15,021), black bullhead (4,521), black crappie (4,117), and bluegill (3,457). Other species transferred were northern pike (1,968), largemouth bass (1,424), smallmouth bass (214), brook trout (205), and redear sunfish (108, Table 20).

Expenditure

When comparing among management regions, Region III expended $21,150.66, which was 54.5% of the total trap and transfer operation expenses in South Dakota during 2007 (Table 20). The total expenditure for trap and transfer operations in South Dakota during 2007 was $38,810.12 (Table 21). The greatest total expense was accrued with the trap and transfer of yellow perch ($10,409.46) followed by walleye ($7,459.36) and largemouth bass ($6,519.07). Costs associated with the trap and transfer of these three species comprised 62.8% of the total trap and transfer expenditures during 2007. Based on the cost for each 1,000 fish transferred, smallmouth bass ($6,167.33) were the most expensive followed by largemouth bass ($4,577.99), brook trout ($4,172.68), northern pike ($2,409.19), and bluegill ($892.50; Table 22). Overall, $506.47 for each 1,000 fish ($0.50 per fish) was invested in the trap and transfer program in South Dakota during 2007.

Table 20. Species, number (number of fish transferred), weight (total weight, lbs.), rate (number/lb.), and total expenditure associated with trap and transfer operations from each region during 2007 (January 1 – December 31).

Species		Transfer			
Common Name	Type	Number	Weight[1]	Rate	Expenditure ($)
		REGION I			
Black crappie	Adult	1,210	---	---	779.40
Bluegill	Adult	95			323.34
Brook trout	Adult	205	---	---	855.40
Redear sunfish	Adult	108			0.00
Channel catfish	--	0	---	---	842.20
Largemouth bass	Adult	250	---	---	431.44
Walleye	Fingerling	150	---	---	48.70
Yellow perch	Adult	600	---	---	311.80
Yellow perch	Fingerling	1,800	---	---	48.70
Overall	---	4,418	---	---	3,640.98
		REGION II			
Black crappie	Adult	155	52	2.9	584.21
Smallmouth bass	Adult	50	17	3.0	436.79
Largemouth bass	Adult	257	86	3.0	1,069.97
Largemouth bass	Fingerling	917	131	7.0	5,017.66
Yellow perch	Adult	509	170	3.0	1,511.71
Overall	---	1,888	456	---	8,620.34
		REGION III			
Black bullhead	Adult	4,521	3,014	1.5	804.25
Black crappie	Adult	2,752	459	6.0	1,410.31
Bluegill	Adult	1,162	154	7.5	595.48
Yellow perch	Adult	4,394	1,033	4.3	3,429.40
Yellow perch	Fingerling	38,290	1,093	35.0	5,107.85
Northern pike	Adult	948	--	--	1,509.69
Walleye	Adult	3,095	1,997	1.5	2,610.98
Walleye	Fingerling	11,776	1,549	7.6	4,799.68
Smallmouth bass	Adult	164	55	3.0	883.02
Overall	---	67,102	9,354	---	21,150.66
		REGION IV			
Bluegill	Adult	2,200	440	5.0	2,166.54
Northern pike	Adult	1,020	510	0.5	3,231.6
Overall	---	3,220	950	---	5,398.14

[1] Total weight data was not provided for trap and transfer operations in Region I.

Table 21. Species, number (number of fish transferred), weight (total weight, lbs.), rate (number/lb.), and total expenditure for statewide trap and transfer operations during 2007 (January 1 – December 31).

Species		Transfer	
Common Name	Type	Number	Expenditure ($)
STATEWIDE			
Black bullhead	Adult	4,521	804.25
Black crappie	Adult	4,117	2,773.92
Bluegill	Adult	3,457	3,085.36
Brook trout	Adult	205	855.40
Channel catfish		0	842.20
Largemouth bass	Adult	507	1,501.41
Largemouth bass	Fingerling	917	5,017.66
Northern pike	Adult	1,968	4,741.29
Walleye	Adult	3,095	2,610.98
Walleye	Fingerling	11,926	4,848.38
Yellow perch	Adult	5,503	5,252.91
Yellow perch	Fingerling	40,090	5,156.55
Smallmouth bass	Adult	214	1,319.81
Redear sunfish	Adult	108	0.00
Overall			
Largemouth bass	---	1,424	6,519.07
Walleye	---	15,021	7,459.36
Yellow perch	---	45,593	10,409.46
All Species	---	76,628	38,810.12

Table 22. Expenditures including total cost, cost per 1,000 fish transferred, and cost per fish associated with trap and transfer operations in South Dakota during 2007 (January 1 – December 31).

Species		Expenditure ($)		
Common Name	Type	Total	Per 1,000	Per Fish
Black bullhead	Adult	804.25	177.89	0.17
Black crappie	Adult	2,773.92	673.77	0.67
Bluegill	Adult	3,085.36	892.50	0.89
Brook trout	Adult	855.40	4,172.68	4.17
Channel catfish	Adult	842.20	N/A	N/A
Largemouth bass	Adult	1,501.41	2,961.36	2.96
Largemouth bass	Fingerling	5,017.66	5,471.82	5.47
Northern pike	Adult	4,741.29	2,409.19	2.40
Walleye	Adult	2,610.98	843.61	0.84
Walleye	Fingerling	4,848.38	406.53	0.40
Yellow perch	Adult	5,252.91	954.55	0.95
Yellow perch	Fingerling	5,156.55	128.62	0.12
Smallmouth bass	Adult	1,319.81	6,167.33	6.16
Redear sunfish	Adult	0	0.00	0.00
Overall				
Largemouth bass	---	6,519.07	4,577.99	4.57
Walleye	---	7,459.36	496.59	0.49
Yellow perch	---	10,409.46	228.31	0.22
All Species	---	38,810.12	506.47	0.50

Summary

During 2007 a total of 101.8 million eggs were incubated, 50.8 million fry were hatched, 1.2 million fingerlings were produced, and 2,000 catchable fish were produced at BDH. In addition, fish production relating to operations in natural rearing ponds provided 12,531 fingerlings. Regional trap and transfer of fishes among waters throughout South Dakota provided 76,628 fish. Specifically, fish production at or associated with BDH yielded the following: 2,000 rainbow trout, 1,490 paddlefish, 5,100 largemouth bass, 104,405 chinook salmon fingerlings, 50,425,000 walleye fry and 1,075,120 walleye fingerlings.

Roughly 30 percent of staff hours at BDH during 2007 were expended on fish culture at the hatchery complex, fish production in natural rearing ponds, stocking fish, and net construction or regional assistance. Similarly, approximately 23 percent of staff hours were expended on maintenance of equipment, hatchery complex buildings, and grounds. BDH personnel provided the public 300 tours through the IE center at the hatchery complex and were involved in educational clinics at water festivals and outreach programs that reached 450 children in grades one through four. Finally, BDH personnel managed and maintained the aquarium exhibit at the South Dakota State Fair that was visited by thousands of South Dakota residents and visitors of South Dakota.

Total BDH expenditures in 2007 were $410,936. Fish production expenditures associated with BDH and other SDGFP fisheries related work were $448,766 (Table 23). A total of $209,048 was expended on walleye production in 2007, which comprised roughly 47 percent of total fish production expenses.

Table 23. Fish production expenditure for Blue Dog Lake State Fish Hatchery and natural rearing ponds (January 1 – December 31, 2007).

Species	Size	Number	Expenditure ($) Per 1000	Expenditure ($) Total
		Blue Dog Lake State Fish Hatchery		
Rainbow trout	Catchable	2,000		8,515
Yellow perch	Fry/Fgl			45,609
Largemouth bass	Fingerling	5,100	-----	47,491
Largemouth bass	Fingerling	403,530	80.79	32,600
Largemouth	Brood	226	-----	17,046
Walleye	Fry	50,425,000	2.47	124,657
Walleye	Fingerling	1,075,120	72.84	78,309
Paddlefish	Fingerling	1,490	---	25,672
Chinook salmon	Fingerling	104,405	1,280	62,785
Overall		---	---	442,684
		Natural Rearing Ponds		
Walleye	Fingerling	12,531	486.55	6,082
Total		52,029,402	---	448,766

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